An examination of the 2,4-D issue

Is there fire where there is smoke?

by Christopher Sann

2,4-D, or 2,4-dichlorophenoxyacetic acid, first registered 45 years ago in the U.S., may be the most widely produced and widely-used pesticide in history. 2,4-D is a simple organic acid that is used as a selective, broad leaf, weed and plant control agent. 2,4-D is used in agriculture and forestry, for weed control on rights-of-way, on range lands, in parks, on golf courses, in water for aquatic weed control, and for commercial and residential turf management.

When 2,4-D is applied to plants it is absorbed through both the leaves and the roots. Once absorbed, it is sent throughout the plant by the vascular system, where it stimulates growth by simulating the action of naturally-occurring plant hormones. Older cells are rejuvenated and young cells are overstimulated causing abnormal growth and plant death. The internal plant functions that are affected by 2,4-D are cell production, enzymatic activity, and the carbon dioxide-oxygen respiration cycle. In addition it affects nucleic acid and protein synthesis, and the flow of water and nutrients through the vascular system. 2,4-D affects all plants to some extent, but it develops its selectivity because broad leaf plants have a larger surface areas than grasses and they absorb more of the material.

It was estimated that almost 70 million pounds of the active ingredient of 2,4-D was produced and used in as many as 1,500 different products and formulations in 1990. With this wide use has come a substantial amount of scientific testing. It was estimated that more than 40,000 scientific articles had been written about 2,4-D by 1978. Many more studies have been conducted in the 15 years since. None of these more than 40,000 studies have raised any significant concerns about the safety of 2,4-D.

A recent history of concerns about safety

Speculation about the safety of the phenoxy herbicide 2,4-D began in the late 1970's with the controversy surrounding the use of 10 million gallons of Agent Orange, a phenoxy-based herbicide mixture that contained 2,4-D. It was sprayed by the U.S. military to defoliate the jungles during the Vietnam war. In that uproar 2,4-D was not suspected as the controversial compound in the mixture but rather a dioxin-contaminated, ester formulated herbicide, 2,4,5-T or Silvex, was believed to have caused a variety of long term symptoms to American soldiers who had direct exposure to the material years before. The 2,4,5-T was itself not suspected of causing the observed problems so much as the dioxin. This dioxin contamination was a by-product of

Notes on 2,4-D studies

by Christopher Sann

As I researched the information for and wrote about the safety of 2,4-D in the preceding article, I became frustrated and bewildered. Frustrated enough that I felt the need to comment on my feelings.

Questionable techniques in control studies

I am frustrated about the use of such questionable survey techniques in the scientific community. Specifically, I don't understand why the researchers associated with the National Cancer Institute continued to release the questionable conclusions of their case control studies on the safety of 2,4-D over a period of five years, when the use of the study technique to establish a direct link between a cause — exposure to 2,4-D — and an effect — elevated levels of three cancers — was highly controversial.

The Institute continued to release its conclusions of successive studies even though the conclusions from its earlier studies had received a universally negative reaction to the design and the execution of those studies when they were examined by peer review panels.

New scientific theories generated by good science

The nature of the scientific process is rife with controversy, and has been for hundreds of years. Controversy may stimulate advances in scientific knowledge because of efforts by scientists to defend their theories in the face of established dogma. But, in order for new theories to displace existing theories, they must have been generated from good science. Good science is a process by which an established set of procedures and protocols are followed to test hypotheses. Without the acceptance and practice of good scientific procedures, all scientific inquiry becomes a complicated version of Abbott and Costello's classic piece "Who's on first?".

Case control studies are a part of good science

Case control studies are a part of good science: they are an established survey technique designed to develop

an hypothesis concerning the possible cause of an occurrence. This is done by using an established format with well-designed procedures to try to establish a possible cause or hypothesis. Once the hypothesis has been developed, then a series of specific, controlled follow-up studies are performed to test the hypothesis. It is the results of these follow-up studies that must support the hypothesis in order for the hypothesis to become accepted as fact.

A well-designed case control study should meet certain criteria. First, it should have an appropriate control group to eliminate as many confounding factors as possible. Second, it should survey a large enough group of individuals so that the results can have statistical significance.

Because of the many unique aspects involved in designing case control studies, there are few if any off-the-shelf design directions to follow. It is left to the individual scientist to account for variables in his design. If the study is not well designed, or if it contains a significant number of sampling errors or confounding variables, then it is imperative that the examining scientist take these weaknesses into account and use caution when formulating his conclusions. If, as is the case with many human case-control studies, the scientist's concern for the specific health implications of the study override these cautions, then it is of utmost importance that the scientist make a major effort to see that his conclusions are rendered in the light of concerns for accuracy.

2,4-D case control studies were flawed

Unfortunately, it does not appear that these cautions or concerns for accuracy were the overriding considerations in the design, execution and conclusions of many of the case control studies on the safety of 2,4-D. All of this would not be of such concern if it weren't for the fact that the concerns for the safety of 2,4-D raised from these studies came at a time when questions about the use of pesticides in general and specifically by turfgrass managers were already at an all-time high. Whether they manage large facilities or home lawns, turfgrass managers are highly visible and are often the public's first and only direct contact with pesticide use or its users. The National Cancer Institute studies have made turfgrass managers' lives considerably more difficult and for no apparent reason.

There is an old saying in the data processing industry that seems appropriate in this context: garbage in, garbage out. ■

manufacturing the 2,4,5-T and it was considered to be difficult to eliminate from the manufacturing process. The contamination of 2,4,5-T by dioxins was known to the members of the chemical manufacturing community in late 1950's and was ignored by the military in their specifications for the manufacture of Agent Orange.

This concern over the phenoxy herbicides in general, coupled with a speculative study published by a Swedish scientist about the potential carcinogenicity of 2,4-D, 2,4,5-T, and their contaminants' connection to several unusual cancers — Hodgkin's disease, soft tissue sarcoma, and non-Hodgkin's lymphoma — led the EPA to issue the following statement in 1980.

"...EPA believes that available information on potential adverse health effects of 2,4-D does not warrant a regulatory action to remove its products from the market. The agency also does not see imminent hazard or unreasonable health effects when 2,4-D products are used according to label instructions and precautions."

This statement was issued despite the fact that the EPA had already suspended the registration and all uses of the suspect herbicide, Silvex.

Six years later, the National Cancer Institute published the results of a study of Kansas farmers. The study stated that a connection existed between the use of phenoxy herbicides for more than 21 days per year and a small increase in non-Hodgkins lymphoma. That study did not single out 2,4-D but covered herbicides in general. In response to some questions about this study, four independent reviews of the methodology employed and the conclusions reached in this Kansas study were initiated. All four of the reviews concluded that the study's conclusion of a cancer risk from exposure to 2,4-D was not supported by the data.

Undaunted, the Institute published a report in 1990 that said the same cancer link existed in a study of Nebraska farmers. A blue-ribbon panel conducted by the Harvard School of Public Health concluded that the link between the herbicide and the cancer that the new Nebraska farmer study had alluded to had not been established.

In 1991 the Institute published the results of yet another study that claimed to establish a link between the use of four applications of phenoxy herbicides per year on home lawns and the development of malignant lymphoma in dogs. Another review of this third Institute study concluded that because of poor design of the study, the conclusions about cancer in dogs was not shown.

Finally, the Institute published a fourth study concluding that there was a slight increase in the occurrence of cancer in Nebraska farmers. This conclusion was made despite the fact that there did not appear to be an increase in the occurrence of the cancer in the surveyed population with the passage of time nor was